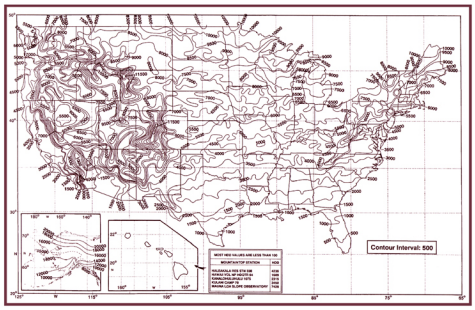
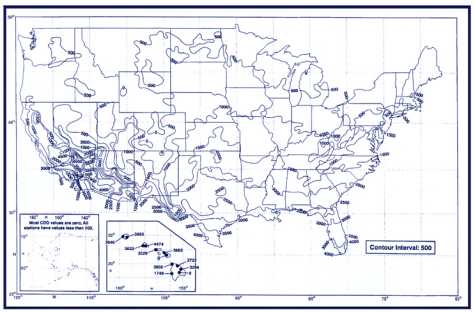
HEATING and COOLING Degree Days



Annual Heating Degree Days
Based on Normal Period 1961-1990



Annual Cooling Degree Days
Based on Normal Period 1961-1990

National Oceanic and Atmospheric Administration
National Climatic Data Center
Asheville, NC

www.ncdc.noaa.gov/oa/edu.html

Background:
When buildings get too cold, fuel is consumed to make them comfortable living space. A useful indicator of fuel consumption for heating purposes is the determination of heating degree days. Heating degree days are calculated by accumulating one unit for each degree the daily mean departs below the base of 65 degrees Fahrenheit (F). Many home electrical and gas bills contain information on energy use that includes data based on heating degree day totals during the billing period.

Heating degree days are an index of "coldness" useful in energy consumption (usage) calculations. The number of heating degree days is calculated for each day by subtracting the day's mean (average) temperature from a base temperature of 65°F. The daily totals are accumulated for each month and the monthly totals are accumulated for the "heating year" running from July through June. The amount of energy consumed for heating is closely correlated (related) to these heating degree days. Thus, a warm location such as south Florida will have much fewer heating degree days than a cold location such as northern Maine.

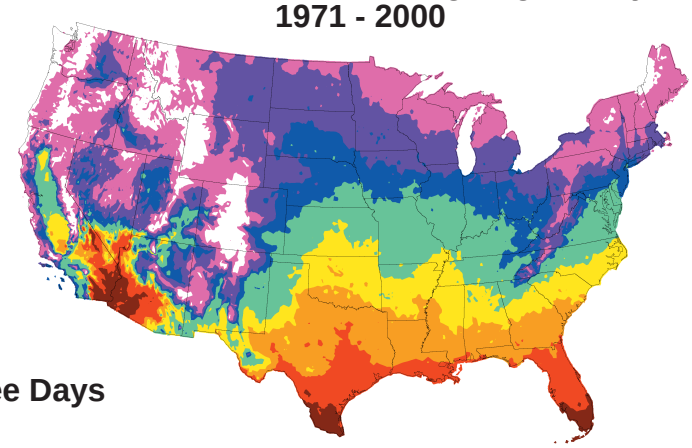
Just as heating degree days are useful in describing coldness for energy consumption (usage), **cooling degree days** describe "warmness" and energy consumption. For cooling degree days, the base temperature of 65°F is subtracted from the day's mean (average) temperature. The daily totals are accumulated for each month and the monthly totals are accumulated for the "cooling year" running from January through December. The amount of energy consumed for cooling is closely correlated (related) to these cooling degree days. Thus, a warm location such as south Florida will have many more cooling degree days than a much cooler location such as northern Maine.

A base of 65°F is used for degree days as scientists found that daily means (averages) less than this caused buildings to likely require some heat to keep the occupants warm while means (averages) greater than this required some building cooling to keep the occupants cool.

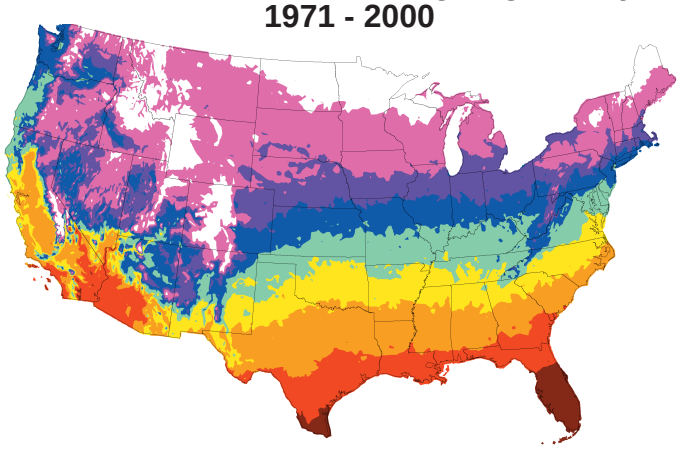
Cooling Degree Days

- < 101
- 101 - 400
- 401 - 700
- 701 - 1000
- 1001 - 1500
- 1501 - 2000
- 2001 - 2500
- 2501 - 3500
- > 3500

Annual Mean Total Cooling Degree Days 1971 - 2000



Annual Mean Total Heating Degree Days 1971 - 2000



Heating Degree Days

- < 1001
- 1001 - 2000
- 2001 - 3000
- 3001 - 4000
- 4001 - 5000
- 5001 - 6000
- 6001 - 7000
- 7001 - 9000
- > 9000

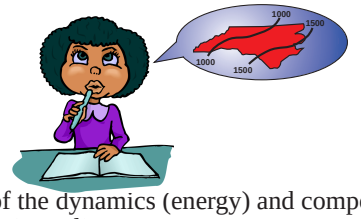
STATE HEATING DEGREE DAYS (DIVISIONS WEIGHTED BY 2000 POPULATION), THRU DEC 2002--BASE TEMP = 65 DEG F

STATE : 31 NORTH CAROLINA SEASON	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
2001/2002	0	0	32	234	304	526	697	574	443	101	65	1
2001/2002	0	0	32	266	570	1096	1793	2367	2810	2911	2976	2977
2001/2002	.0	.0	114.3	109.5	84.3	80.1	83.2	85.4	86.9	84.5	84.6	84.5
2002/2003	0	0	6	140	497	761	0	0	0	0	0	0
2002/2003	0	0	6	146	643	1404	0	0	0	0	0	0
2002/2003	.0	.0	21.4	60.1	95.1	102.6	.0	.0	.0	.0	.0	.0

STATE COOLING DEGREE DAYS (DIVISIONS WEIGHTED BY 2000 POPULATION), THRU DEC 2002--BASE TEMP = 65 DEG F

STATE : 31 NORTH CAROLINA YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2001	0	0	2	19	114	303	319	381	128	20	9	5
2001	0	0	2	21	135	438	757	1138	1266	1286	1295	1300
2001	.0	.0	14.7	76.9	98.3	108.5	96.6	100.2	95.9	94.4	94.9	95.1
2002	3	0	8	51	98	330	451	391	237	57	0	0
2002	3	3	11	62	160	490	941	1332	1569	1626	1626	1626
2002	83.3	69.8	80.9	227.1	116.4	121.4	120.1	117.3	118.8	119.3	119.1	119.0

Activity:
Temperatures and Heating Degree Days



Content Area/Course:
Earth/ Environmental Science
Grade Level:
9-12
Competency Goal:
The learner will build an understanding of the dynamics (energy) and composition of the atmosphere and its location and global processes influencing climate and air quality.
Indicators:
Explains concepts such as temperature, the water cycle, gravitation, states of matter, chemical concentration, and energy transfer.
Project 2061 Benchmark:
Weather (in the short run) and climate (in the long run) involve the transfer of energy in and out of the atmosphere. Solar radiation heats the land masses, oceans, and air. Transfer of heat energy at the boundaries between the atmosphere, the land masses, and the oceans results in layers of different temperatures and densities in both the ocean and atmosphere. The action of gravitational force on regions of different densities causes them to rise or fall—and such circulation, influenced by the rotation of the earth, produces winds and ocean currents. Upon completing this investigation, the student should be able to explain how heating degree day units are calculated, determine the pattern of heating needs across the country, and list possible factors which contribute to the variations in total annual heating degree day units in the United States.
Approximate Time Required:
45 minutes
Prior Knowledge/ Skills Required for Task:
Working knowledge of climate and atmospheric changes

Materials and Resources Needed:
Map and colored pencils
Introduction:
This activity focuses on the pattern of annual totals of heating and cooling degree day units across the country.
Procedure:
As described above, heating degree days are calculated by assigning one unit to each degree the daily mean temperature departs below the base of 65 degrees Fahrenheit. The daily mean temperature is the average of the maximum and minimum temperatures for any given day. For example , a day with a high temperature of 70 degrees and a low of 50 degrees has a mean temperature of 60. The subtraction of 60 from 65 results in 5 heating degree day units for that day.

The accompanying maps display the average annual total number of heating degree day units accumulated at locations around the country. Analyze the map by drawing on the map bands of colors representing 1,000-units ranges. To start, shade with a red pencil all locations having values from 0 to 1000. Form a red band by filling in all areas. Use another color, say orange, and follow the same procedure for locations with values from 1001 to 2000. Use yellow for 2001 to , green for 3001 to 4000, blue for 4001 to 5000, and so on until the map is fully analyzed. Widen adjoining color bands until they meet at sharply defined borders. Remember only colors representing adjacent ranges of values can come in direct contact. A similar activity can be conducted with the cooling degree map.

Activities:
1. Calculate the number of heating degree day units for a day when the maximum temperature was 40 degrees Fahrenheit and the minimum temperature was 20 degrees. Show your work.
2. How many heating degree day units would be produced on days when the mean daily temperatures were 65 and 70 degrees Fahrenheit respectively? Explain your answers.
3. Examine the analyzed map. Where on the map are annual heating degree day totals highest? Lowest?
4. Describe the general pattern of heating degree days across the contiguous states of the United States as revealed by your map analysis. What broad sections have the highest and lowest heating demands?
5. According to the map, in what ways might the following factors impact the total number of annual heating degree-day units: latitude, altitude, nearness to large bodies of water? What are some other factors that might be involved?
6. Fuel is also consumed when temperatures get too hot since living environments need cooling under those conditions. Cooling degree day units are calculated when mean daily temperatures are above a certain value, such as 65 degrees Fahrenheit. Where in the United States do you think annual cooling degree day totals would be greatest? Lowest?